Early Journal Content on JSTOR, Free to Anyone in the World

This article is one of nearly 500,000 scholarly works digitized and made freely available to everyone in the world by JSTOR.

Known as the Early Journal Content, this set of works include research articles, news, letters, and other writings published in more than 200 of the oldest leading academic journals. The works date from the mid-seventeenth to the early twentieth centuries.

We encourage people to read and share the Early Journal Content openly and to tell others that this resource exists. People may post this content online or redistribute in any way for non-commercial purposes.

Read more about Early Journal Content at http://about.jstor.org/participate-jstor/individuals/early-journal-content.

JSTOR is a digital library of academic journals, books, and primary source objects. JSTOR helps people discover, use, and build upon a wide range of content through a powerful research and teaching platform, and preserves this content for future generations. JSTOR is part of ITHAKA, a not-for-profit organization that also includes Ithaka S+R and Portico. For more information about JSTOR, please contact support@jstor.org.

THE LARVAL THEORY OF THE ORIGIN OF CELLULAR TISSUE.

BY PROFESSOR ALPHEUS HYATT.

AT a meeting of the Boston Society of Natural History, held March 5, Professor Hyatt reviewed the history of investigations upon the structure of the Porifera; concluding that though true Metazoa, they nevertheless still retained characteristics of Protozoa. They possess, in adults, the three typical layers, ectoderm, mesoderm and endoderm, and reproduce by means of true nucleated eggs and spermatozoa developed in the mesoderm. The embryos in the lower forms develop, as observed by him and figured by Barrois in Halisarca, by passing through a hollow morula, as do also several species of the higher forms of Carneospongiæ, having silicious spicules, which are now by most authors supposed to have only a solid morula.

The differentiation of the egg is slightest in forms like Halisarca, and possibly also in Gastrophysema, one of the Calcispongiæ; if Haeckel's figures of these really represent sponges. In the higher forms of both Carneospongiæ and Calcispongiæ, especially the latter, the eggs become differentiated into endoderm and ectoderm at a very early stage of segmentation, and all larval stages are much shortened, in accordance with the law of concentration and acceleration in development. This law is founded upon the fact, now generally established by observation, that the young of descendant types inherit characteristics and tendencies, or habits, at earlier stages than those in which they first originated in their ancestors.[1]

Thus the young of Sycandra is the exact structural parallel of the adult of Leucosolenia, a genus of a lower order, Ascones. It is at first a tube with thin walls as in Leucosolenia, and then develops the characteristics of its own order, Sycones, forming a thick wall, and the cœlomatic cavity branches into radiating tubes, keeping up connection with the exterior through open external pores. The cells in the main cavity of the larva, which are all flagellated and collared, lose their cilia and collars except where the enlargements of the branches occur, forming the ampullæ, the essential characteristic gastric cavities of all sponges with thick mesoderm.

---

[1] See Evolution of Cephalopods, *Science*, Nos. 52–53, and Genera of Fossil Cephalopods, Proc. Bost. Soc. Nat. Hist., Vol. XXII, p. 262.

The three layers can be exactly compared with the three layers of all the Metazoa, the outer, the ectoderm, is essentially a protective and respiratory layer, the inner, the endoderm, is devoted in Ascones to digestion, or rather consists wholly of feeding zoöns, the central, the mesoderm, is a supporting layer secreting the primitive spicular skeleton, as in Hydrozoa, Actinozoa and all Metazoa. This skeleton, in its spicular character, is similar to the primitive condition of the skeleton in most and perhaps throughout all the Metazoa, the mode of formation being essentially at first spiculous and then solidified through the binding together of the loose elements remotely comparable with the spicules of Porifera. It will be noticed also that in sponges the products of the mesoderm are largely inorganic, as in the skeleton in the Metazoa, and the products of the ectoderm are also horny, as in the Metazoa. The skeleton of Keratosa, the well known webs of elastic threads, which compose the masses known as commercial sponges, are not products of the mesoderm, but really built by the ectoderm.

The process of digestion in Ascones and in the ampullæ is purely protozoönal. The cells capture food, living and in an unprepared condition, from the water coming in through the pores. They must be admitted to have retained both the structure and the habits of the flagellate Protozoa, as has been shown by Clark, Carter and Saville Kent. They are really a distinct branch on the lower borders of the Metazoa, derived from the Protozoa, and equal taxonomically to either Hydrozoa or Actinozoa, forming in fact parallels to the first in their development of the cœlomatic cavity and gastrovascular system, and even uniting, in this respect, the two systems of the Echinodermata, the water and gastric system, into one system with two sets of tubes. They have, in fact, the incurrent or supply system formed by the ectoderm connecting with the cloacal outlet system formed by the endoderm in all the fleshy sponges, Sycones and Leucones.

Every sponge may, however, be morphologically considered, when reduced to its simplest elements, as a sac of collared and flagellated cells surrounded by the mesoderm and inclosed in the ectoderm. This sac has but one opening, an excurrent and incurrent aperture, but this opening is not the blastopore or primitive mouth of the gastrula stage. It occurs by a breaking through at the opposite pole of the body after the attachment of the larva, which occurs mouth downwards, as shown by Schultze in Sycandra. This primitive opening is also present at an earlier stage in the free larvæ of all the higher forms of Carneospongiæ. Haeckel's parallel between the development of the egg and the evolution of forms among Protozoa, from the unnucleated to the nucleated, seems to be correct, and the morula can be equally closely compared with the colonial free forms of Flagellata like Uvella and Volvox. Recent investigations by Balbiani, Bütschli and Engelmann have removed almost every obstacle, which formerly existed, to the close homology of the single cell among Metazoa with a full-grown adult Protozoön. We can now even closely compare the nuclei of the Protozoa and its changes during conjugation and subsequent casting off of part of the nucleus, to the casting off of polar cells in the egg. The heads of the spermatozoön in the Calcispongiæ have been shown, by Poléjaeff, to arise from division of a part of the nucleus, the other or central part either remaining quiescent or, as this author states, form the tails. Almost every author, especially La Vallette St. George, the most thorough student of this subject, consider all spermatozoa as derived from simple processes of cell division. The essential and general character of reproduction among Protozoa is similar, being, as is well known to observers, fissiparous division of the whole body, but this division takes place in the adults at the end of a series of transformations, and is not characteristic of larval stages. The building up of the tissue in Metazoa is due to the quick and rapid division of cells, and if it is granted that Metazoa may be aggregates of Protozoa, they must be considered, in fact, larval forms descended from Protozoa and inheriting the tendency to reproduction, by fissiparous division, at an early stage. In other words, they reproduce while still larvæ and before passing through any transformations, except the very primitive ones which precede and include the nucleated stage.

We can account for the three layers, by supposing that there must have been among the protozoönal ancestors of the Metazoa transitional forms which were colonial, and in which a part of the feeding zoöns, the collared and flagellated cells, became differentiated into flattened protective zoöns. The next stage would be represented by another form, in which to these two classes of zoöns, a third would be added in the shape of supporting zoöns. We can readily imagine all of these as attached colonies, and even think of the supporting zoöns, which represent the inclosed mesoderm of Metazoa, as resting on the ground. The inclosure might have been simply due to concentration in the larvæ of descendant forms, which connected them with the Metazoa, since this would be a natural sequence of inheritance with concentration of the secondary formation of the mesoderm. Of course this picture can only indicate what seems to us the probable course of the morphology, and also our disposition to regard as unfounded all hypotheses which have asserted that essential structural characters originate, as a rule, in larval stages, or are likely to occur without being derived through inherited concentration of characteristics from former generations. Simultaneously with the differentiation of supporting or mesodermic zoöns, we should also expect to find male and female zoöns arising, if the results of investigations among sponges mean anything, from among the supporting zoöns, or becoming, at least in the immediate transitional forms, confined to this layer.[1]

It is not of course necessary to this hypothesis that no other transitional forms occurred leading to other types of Metazoa, or that all reproductive zoöns originated in the mesoderm. As larval forms, the spermatocysts would inherit the tendencies to spontaneous fission of the nucleus at earlier stages in the successive forms, and the resulting cells or fertilizing elements would acquire the capacities and the habits of the full-grown ancestors, if they also are larval forms. The parallel between the encystment of the spermatocyst in the sponge tissue, and of the adult among Protozoa is closely similar. The process of spontaneous fission takes place in both bodies in similar way after their encystment.

---

[1] Since the above was written we have received Biologisches Centralblatt for March 1st, 1884, in which Bütschli, the noted student of Protozoa, announces that a colony of Volvox has male and female zoöns as individuals, and that the male produces by division secondary forms which, like spermatozoa, seek out and fertilize the female. Thus Bütschli has discovered the intermediate forms with males and females required by the hypothesis above, and adds exactitude to our theoretical comparisons of the spermatozoa, since in Volvox we have a directly transitional male form, and also, we may add, in Vorticella. We cannot, however, at all join Bütschli in regarding the spermatocyst and the ovum as the morphological representatives respectively of the exclusive male colonies and female colonies of some Protozoa like the Endrina. This would be assuming every cell to be primarily unisexual, either male or female, our standpoint being with Minot and Balfour, that they are primarily sexless or bisexual, that is hermaphrodites, and the sexes the result of independent differentiation.

The products in both cases are the tailed locomotive forms, which are, according to all observers, probably true single cells, which, from the earliest period of their discovery, have been compared or identified with the locomotive monads, the products of the encysted stage in many of the Protozoa.

The essential difference between a spermatocyst and its homologue among Protozoöa consists in the fact that the latter has to become a full-grown feeding zoön before it is ripe, and proceeds to produce by division secondary males, which seek out the female for the purposes of impregnation, while the latter, as its descendant, has acquired by concentration of development, the same powers and habits in its earliest stage, and its sole function is to become encysted and produce larval male cells for the impregnation of the female zoön or ovum. The impregnation in both cases immediately precedes the reorganization of the nucleus of the female (ex. Vorticella), and are followed by a period of reproduction by division, which is infinitely more concentrated in the encysted ovum, as an encysted larval form, than in the free adult Protozoön. The former is thus a builder of close-set tissues composed of larval cells, and the latter of loosely associated colonies of adult feeding zoöns.

——:o:——

THE NATURALIST BRAZILIAN EXPEDITION.

PAPER III.—SÃO JOÃO DO MONTE NEGRO.

BY HERBERT H. SMITH.

(Continued from page 1014, October number, 1883.)

ABOUT the middle of February we changed our residence to the village of São João do Monte Negro, which lies on the Rio Cahy, a northern branch of the Guahyba. Small steamboats run up this river from Porto Alegre nearly every day, touching at the various German colonies along the banks, and bringing down mandioca-meal, corn, beans, tobacco and other products.

The Cahy is very crooked, and the lower portion is bordered by a wide flood-plain. The clay banks are steeply cut, and often thirty feet high, so as to be beyond reach of all except the strongest floods. They are covered in many places with heavy forest, leguminous trees and myrtles being abundant; the branches are draped with vines, and palms of one or two kinds are often